CONNECTICUT RIVER BASIN
GARDNER , MASSACHUSETTS

PERLEY BROOK RESERVOIR DAM
MA 00119

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1980

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Perley Brook Reservoir Dam is a 1000 foot long earthfill dam. Thd dam has a maximum height of 50 feet with the top at Elevation 1032.0. The dam is in fair condition. The dam has been classified in the "intermediate" size and "high" hazard categories. A test flood equal to the full PMF was used to evaluate the capacity of the spillway.

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PERLEY BROOK RESERVOIR DAM

MA 00119

MERRIMACK RIVER BASIN
GARDNER, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00119

Name of Dam: Perley Brook Reservoir

Town: Gardner

County and State: Worcester County, Massachusetts

Stream: Perley Brook, tributary of the Merrimack River

Date of Inspection: May 12, 1980

Perley Brook Reservoir Dam is a 1000-foot long earthfill dam built in 1967. The dam has a maximum height of 50 feet with the top at Elevation (El) 1032.0. The water in Perley Brook Reservoir is used as a secondary water supply by the City of Gardner. The spillway is a morning glory type structure with a crest 35.5 feet in diameter at El 1025.0. A pumping station supported by concrete piers is located over the crest of the spillway. The low-level outlet is a 2-foot diameter pipe controlled by a sluice gate with an invert at El 993.3. The spillway and low-level outlet discharge into a 12-foot diameter outlet pipe through the dam and into a stilling basin. There are four small earthfill dikes along the west side of the reservoir two of which would impound the water during flood stages.

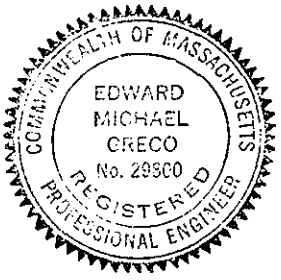
There are deficiencies which must be corrected to assure the continued performance of this dam. This conclusion is based on the visual inspection of the site and a review of the available data. Generally the dam is in fair condition.

The following deficiencies were observed at the site: seepage along the downstream toe; sinkholes at the toe of the upper downstream slope; leakage from the concrete near the bottom of the spillway shaft; leakage through the joints of the outlet pipe; erosion of the downstream slope adjacent to the stilling basin; growth of brush and trees on the downstream slope; and debris in the sluice gate chamber, in the downstream channel, and on the crest of the spillway.

Based on Corps of Engineers' guidelines, the dam has been classified in the "intermediate" size and "high" hazard categories. A test flood equal to the full probable maximum flood (PMF) was used to evaluate the capacity of the spillway. The drainage area for Perley Brook Reservoir is 2.73 square miles. The test flood inflow is calculated to be 3410 cubic feet per second (cfs). The test flood outflow is 2910 cfs, resulting in a pond level at El 1032.4. The test flood would overtop the dam by 0.4 foot and would overtop the dikes by a maximum of 0.7 foot. Hydraulic analyses indicate that the spillway can discharge 2700 cfs, or 93 percent of the test flood outflow before the dikes are overtopped.

It is recommended that the Owner employ a qualified registered professional engineer to conduct a stability analysis of the dam, including an investigation of the seepage and sinkholes on the downstream slope. The Engineer should also make recommendations on repairing the leakage near the bottom of the spillway shaft and from joints in the outlet pipe. In addition, the Owner should repair the deficiencies listed above, as described in Section 7.3. The Owner should also implement a program of annual technical inspections, a plan for surveillance of the dam during and after periods of heavy rainfall, and a plan for notifying downstream residents in the event of an emergency at the dam.

The measures outlined above and in Section 7 should be implemented by the Owner within a period of 1 year after receipt of this Phase I Inspection Report.



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This Phase I Inspection Report on Perley Brook Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

RICHARD J. DIBUONO, Member
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, Member
Geotechnical Engineering Branch
Engineering Division

CARNEY TERZIAN, Member
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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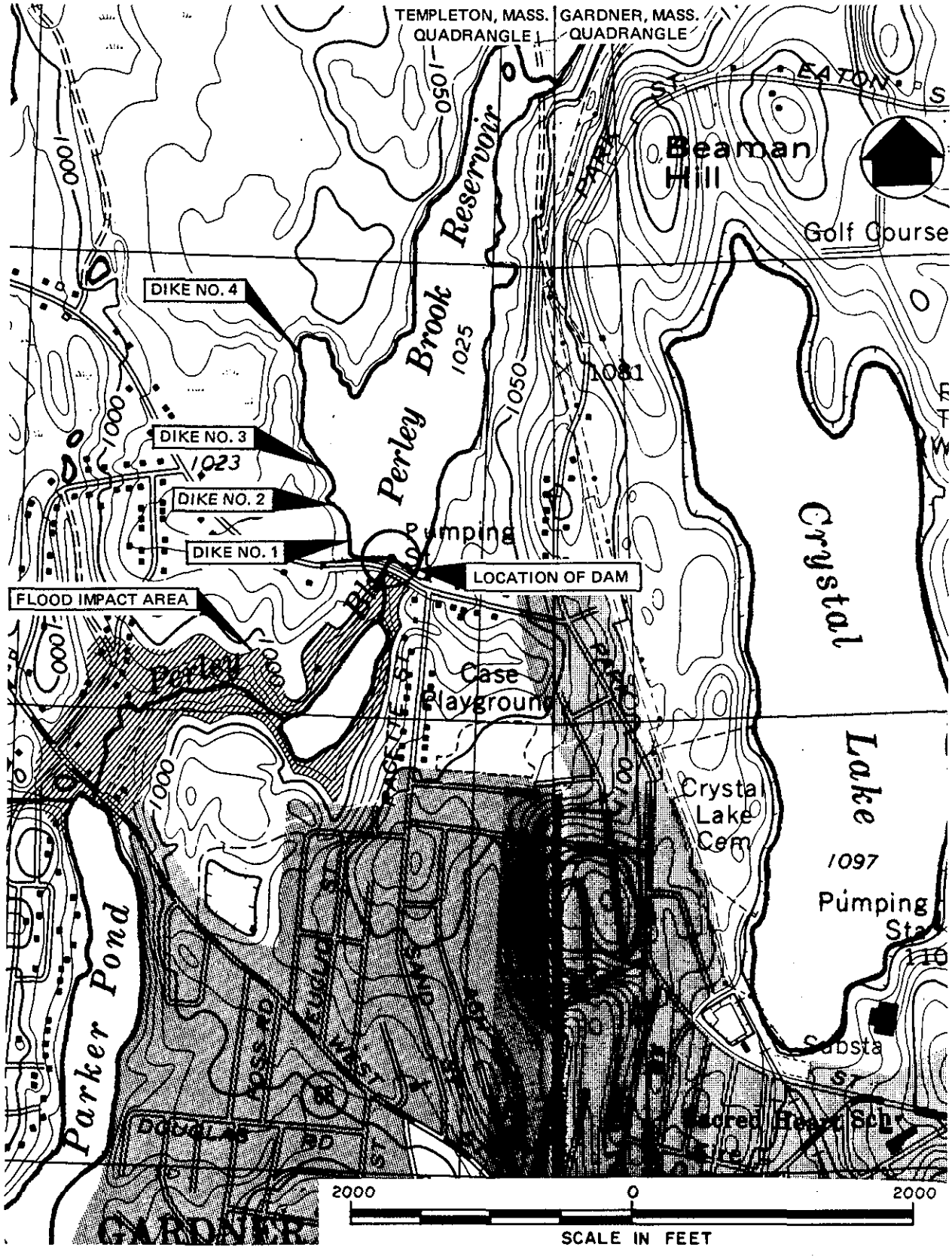
GARDNER, MASSACHUSETTS



LOCATION MAP – PERLEY BROOK RESERVOIR DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

PERLEY BROOK RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-80-C-0054, dated April 18, 1980, has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to quickly initiate effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located on Perley Brook, about 1.4 miles upstream of the confluence with the Otter River, in the Merrimack River Basin. The dam is in the City of Gardner, Worcester

County, Massachusetts (see Location Map). The coordinates of this location are Latitude 42 deg. 35.3 min. north and Longitude 72 deg. 0.3 min. west.

b. Description of Dam and Appurtenances. Perley Brook Dam is a 1000-foot long, earthfill dam with a maximum height of 50 feet (see Plan of Dam and Sections in Appendix B and photographs in Appendix C). The top of the dam is about 40 feet wide and varies from El 1032.0 to 1034.5 National Geodetic Vertical Datum (NGVD) of 1929. Clark Street is located on the top of the dam. The upstream face is a 2.5:1 (horizontal:vertical) slope covered with riprap (shown as rockfill on the drawings). The downstream slope is divided into an upper and lower slope by a 100-foot wide bench (see overview photograph). The upper slope is 2:1 and covered with boulders and grass. The bench slopes at 3 percent and the lower slope is 1.5:1. The bench and lower slope are covered with some grass and vegetation. Available drawings indicate that the dam is an unzoned embankment comprised mainly of impervious fill (see Figure B-3). The drawings also show that the dam is founded partially on rock and partially on glacial till with a cutoff trench 1 to 12 feet below the base of the dam. There is a total of 6 observation wells located on the downstream slope of the dam, 3 at Station 6+50 and 3 at Station 4+50 (see Photo No. 5).

The spillway, located upstream near the midpoint of the dam, is a concrete morning glory weir 35.5 feet in diameter. Concrete piers support a brick pumping station over the spillway crest, and a concrete service bridge extends from the top of the dam to the pumping station (see Photos No. 1 and 2). Four strands of barbed wire between the concrete piers act as a log boom.

The crest of the spillway is at El 1025. The spillway discharges into a 12-foot diameter reinforced concrete outlet pipe through the dam and into a stilling basin (see Photo No. 4). The stilling basin is a rectangular

concrete channel with baffle blocks in the bottom. The invert of the stilling basin is at El 985.

The discharge channel below the dam is 20 feet wide (see Photo No. 3). The floor of the channel is lined with dumped rock and slopes at 1.5 percent.

The low-level outlet is a 2-foot diameter reinforced concrete pipe that connects a 5-foot diameter intake pipe with the 12-foot diameter outlet pipe through the dam (see Plan of Spillway on Figure B-4). Flow through the low-level outlet is controlled by a sluice gate located in a concrete chamber next to the spillway. The invert of the 5-foot intake pipe is at El 991.8 and the invert of the sluice gate is at El 993.3.

Four small earthfill dikes ranging from 2 to 5 feet in height are constructed across low areas along the west side of the reservoir (locations shown on Location Map). The dikes are 70 to 150 feet long with the tops ranging from El 1031.7 to 1032.3. Dikes 2 and 3 have been breached because water reportedly ponded on the downstream sides and flooded neighboring basements. Therefore these dikes are no longer considered effective impounding structures. A typical section through the dikes is shown on Figure B-5 and photograph No. 8 shows Dike 4.

c. Size Classification. Perley Brook Reservoir Dam has a maximum height of 50 feet and a maximum storage capacity of 1100 acre-feet. The storage capacity places the dam in the "intermediate" category which ranges from 1000 to 50,000 acre-feet.

d. Hazard Classification. There are about 20 mobile homes located along Perley Brook downstream of the dam (see Flood Impact Area shown on the Location Map). The foundations of these structures are approximately 3 feet above the streambed. Complete failure of the dam, would result in a downstream flood wave

37 feet deep, as compared to an 8-foot depth prior to failure. More than a few lives could be lost and an excessive amount of property damage could occur. Accordingly, the dam has been placed in the "high" hazard category.

e. Ownership. The dam is owned by the City of Gardner Water Department, off Woodland Avenue, Gardner, Massachusetts 01440. Mr. Avery Newton (telephone 617-632-1956) granted permission to enter the property and inspect the dam.

f. Operator. The dam is operated by personnel from the City of Gardner, Water Department.

g. Purpose of the Dam. The water in Perley Brook Reservoir is used as a secondary water supply by the City of Gardner.

h. Design and Construction. A 265-foot long, 10-foot high concrete dam existed at the site prior to construction of Perley Brook Reservoir Dam. The original dam was left in place at the base of the new dam (see Figure B-3) except in the spillway and outlet works area. Construction of Perley Brook Reservoir Dam was completed in 1967. Drawings dated March 1962 and prepared by Camp Dresser and McKee, Inc. are available. The drawings show that the dam was constructed essentially as it appears today.

Previous inspection reports indicate that since construction the dam has been in good condition. No repairs have been made.

i. Normal Operating Procedures. Personnel from Water Department reportedly visit the dam once a day to check the pumps. Normally, only one of the two pumps is used part time. Each pump is 75 horsepower and capable of pumping 2.8 million gallons of water a day. Water is transmitted by a 14-inch pipeline under Clark Street and discharges into Crystal Lake. Water is pumped from Crystal Lake into the distribution system. The low-level outlet was last opened 5 years ago to add water to downstream ponds for recreational purposes.

1.3 Pertinent Data

a. Drainage Area. The approximately 1747-acre (2.73 square mile) drainage area consists of hilly land (see Figure D-1 in Appendix). The drainage area includes drainage from Cowee Pond. About 4.4 percent of the drainage area is ponds and swamps. In general, the undeveloped portions of the drainage area consist of 90 percent woodland, and 10 percent open fields. The watershed is generally undeveloped.

b. Discharge. Discharge from Perley Brook Reservoir Dam flows uncontrolled over the spillway and into a 12-foot diameter outlet pipe, through a stilling basin and into a stone-lined discharge channel. Water from the low-level outlet also discharges into the outlet pipe.

(1) Outlet: 2-foot diameter, Invert El 993.3, discharge capacity at top of dam - 80 cfs.

(2) Maximum known flood at damsite: unknown

(3) Ungated spillway capacity at top of dam 2700 cfs at El 1031.7 (top of dikes)

(4) Ungated spillway capacity at test flood elevation: 2710 cfs at El 1032.4

(5) Gated spillway capacity at normal pool elevation: N/A

(6) Gated spillway capacity at test flood elevation: N/A

(7) Total spillway capacity at test flood elevation: 2710 cfs at El 1032.4

(8) Total project discharge at top of dam elevation: 2700 cfs at El 1032

(9) Total project discharge at test flood elevation: 2910 cfs at El 1032.4

c. Elevation (feet above National Geodetic Vertical Datum of 1929 (NGVD)). A benchmark was established at El 1006.0 the top of the

stilling basin wall. This elevation was taken from the drawings.

(1) Streambed at toe of dam: 985.0-floor of stilling basin

(2) Bottom of cutoff: variable

(3) Maximum tailwater: 984.7 - water surface downstream of Perley Brook

(4) Normal pool: 1025.0

(5) Full flood control pool: N/A

(6) Spillway crest: 1025.0

(7) Design surcharge (Original Design): 1029.0

(8) Top of dam: 1032.0 to 1034.5
Top of dikes: 1031.7 to 1032.3

(9) Test flood surcharge: 1032.4

1025.0
985.0
40.0

1032.4
1025.0
7.4

d. Reservoir (Length in feet)

(1) Normal pool: 3750

(2) Spillway control pool: 3750

(3) Spillway crest pool: 3750

(4) Top of dam: 3750

(5) Test flood pool: 3750

e. Storage (acre-feet)

(1) Normal pool: 730 at El 1025.0

(2) Flood control pool: N/A

(3) Spillway crest pool: 730 at El 1025.0

(4) Top of dam: 1100 at El 1031.7

(5) Test flood pool: 1140 at El 1032.4

f. Reservoir surface (acres)

(1) Normal pool: 55

(2) Flood-control pool: N/A

(3) Spillway crest: 55

*(4) Test flood pool: 55

*(5) Top of dam: 55

g. Dam

(1) Type: earthfill

(2) Length: 1000 feet

(3) Height: 50 feet

(4) Top width: 40 feet

(5) Side slopes: upstream - 2.5:1
downstream - 2:1 (upper),
1.5:1 (lower)

(6) Zoning: unzoned - impervious fill

(7) Impervious core: N/A

(8) Cutoff: trench of impervious fill extending 1 to 12 feet below dam; concrete collars around outlet pipe at 5 locations

(9) Grout curtain: none

(10) Other: four earthfill dikes 2 to 5 feet high 70 to 150 feet long, located along west side of reservoir, unzoned embankments of impervious fill with side slopes 2.5:1 upstream, 2:1 downstream (2 are breached).

*Based on the assumption that the surface area will not significantly increase with changes in pool elevation from 1025.0 to 1034.5.

h. Diversion and Regulating Tunnel N/A

i. Spillway

(1) Type: morning glory

(2) Length of weir: 35.5 foot diameter reduces to 12 foot diameter outlet pipe

(3) Crest elevation: 1025.0

(4) Gates: none

(5) Upstream channel: none

(6) Downstream channel: 12-foot diameter concrete pipe through dam discharges into stilling basin and then into 20-foot wide, stone-lined stream channel.

j. Regulating Outlets

(1) Invert El: 993.3 at sluice gate

(2) Size: 2-foot diameter

(3) Description: reinforced concrete pipe

(4) Control mechanism: sluice gate

(5) Other: intake is 5-foot diameter pipe with invert at El 991.8; sluice gate discharges into 12-foot diameter outlet pipe through dam

SECTION 2

ENGINEERING DATA

2.1 General. The engineering data available for this Phase I inspection include 18 drawings dated March 1962 and computations dated January 1962 and April 1967 prepared by Camp Dresser and McKee (see Figures B-1 to B-5). The drawings were obtained from their office with the Owner's permission. There are no specifications, other drawings, or computations available from the Owner, State, or County agencies. Copies of previous inspection reports dated 1965 to 1968, prepared by the Worcester County Engineer's Office are included in Appendix B.

We acknowledge the assistance and cooperation of personnel from the Massachusetts Department of Environmental Quality Engineering, Division of Waterways; the Massachusetts Department of Public Works; and the Worcester County Engineers Office. In addition, we acknowledge the assistance of Mr. Avery Newton, Water Superintendent for the City of Gardner, who provided information on the history and operation of the dam.

2.2 Construction Records. The drawings and some construction records for the dam and appurtenances are available at the above-mentioned consultant's office. Previous inspection reports by the Worcester County Engineer's office also provided some construction information.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site. Pump operation time is the only data recorded and available at the pumping station. Rainfall is measured at the Crystal Lake pumping station.

2.4 Evaluation

a. Availability. There is some engineering data available for this dam.

b. Adequacy. The lack of detailed geotechnical and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on the visual inspection, past performance history, and engineering judgment.

c. Validity. Comparison of the available drawings with the field survey conducted during the Phase I inspection indicates that the available information is valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Perley Brook Reservoir was performed on May 12, 1980. A copy of the inspection checklist is inlcuded in Appendix A. Previous inspections were conducted by the Worcester County Engineer's Office from 1965 to 1968. Copies of those reports are given in Appendix B. Selected photographs taken during the Visual Inspection are included in Appendix C.

b. Dam. The dam is an earthfill structure with a morning glory spillway, and a low-level outlet. Evidence of seepage was noted at 7 locations near the downstream toe of the dam. The seepage is indicated by streams of water containing red sediment and flowing at an average rate of 1 gpm (see Photo No. 7).

Several sinkholes 1 to 4 feet deep and up to 5 feet wide are located at the toe of the upper downstream slope of the dam (see Photo No. 6). Observation wells are located at the top, middle, and bottom of the upper downstream slope at Stations 4+50 and 6+50. The water level elevations and ground surface elevations are tabulated below:

	Elevations	
Locations	Ground surface	Water level
Stations 4+50		
top	1033.5	could not open well
middle	1021.1	1005.6
bottom	1012.5	999.4
Station 6+50		
top	1033.0	1008.7
middle	1019.3	1000.8
bottom	1009.0	996.2

Erosion from surface runoff and trespassing was noted along the wing walls of the stilling basin (see Photo No. 3). The earthfill is unprotected in this area.

The riprap on the upstream face of the embankment appears to be intact.

Brush and trees from 1 to 3 inches in diameter are growing on the downstream slopes of the dam (see Photo No. 5).

c. Appurtenant Structures. The morning glory spillway is a circular vertical shaft that discharges into a nearly horizontal outlet pipe through the dam. At the time of the inspection, water was discharging over the spillway, so the weir and shaft could not be thoroughly examined. The concrete on the crest of the spillway was in fair condition with some deterioration. Some wood debris was caught on the crest. Efflorescence and leakage were observed around the concrete plug located where the 5-foot diameter low-level intake pipe intersects the vertical shaft at the bottom of the spillway.

The outlet pipe is in fair condition. Severe efflorescence exists at all joints in the concrete, and leakage is occurring from two joints. The flow was approximately 0.5 gpm. The downstream end of the outlet is clear of debris. The stilling basin is in good condition; minor efflorescence was noted at one location on the west wall.

The concrete and brickwork on the pumping station are in good condition, and the concrete on the service bridge to the pumping station is also in good condition.

The sluice gate and gate chamber for the low-level outlet were visible from the outlet pipe during inspection. The sluice gate is reportedly operable, however, the chamber is clogged with wood and trash debris.

d. Reservoir Area. The reservoir is generally undeveloped. Most of the land is wooded with gentle slopes. There is little potential that future development will occur in the reservoir area.

e. Downstream Channel. Both the spillway and the low-level outlet discharge into the downstream channel. The floor of the channel is lined with rock fill. There is a slight accumulation of debris on the floor of the channel.

Vegetation and trees are overhanging the sides of the channel (see Photograph No. 3).

About 300 feet downstream of the dam the discharge enters an unnamed pond which is about 1100 feet long. The flow continues down Perley Brook, under West Street, and into Parker Pond. Parker Pond is approximately 3500 feet long. Perley Brook flows out of Parker Pond and into the Otter River.

3.2 Evaluation. The visual inspection indicates that the dam is in fair condition. There are some deficiencies which must be corrected to assure the continued performance of this dam. Measures to improve this condition are stated in Section 7.3.

SECTION 4

OPERATING AND MAINTENANCE PROCEDURES

4.1 Operating Procedures

a. General. There are no regular operating procedures for this dam. Personnel from the City of Gardner Water Department reportedly visit the dam once a day to check the pumps when they are in operation.

It was reported that the City of Gardner, Engineering Department was responsible for reading the water levels in the observation wells. However, it was not known when the last readings were taken, as no records were available.

Water pumped out of Perley Brook Reservoir is carried out via a 14-inch pipeline to Crystal Lake, located about 0.5 mile east. Water is then pumped out of Crystal Lake and into the distribution system.

b. Warning System. There is no warning system in effect at this dam.

4.2 Maintenance Procedures

a. General. The dam is generally not adequately maintained. The Water Department is responsible for maintenance of the facility. Periodic maintenance inspections by the Water Department Superintendent have been conducted in the past. Typical maintenance procedures have included clearing debris from the spillway and outlet and mowing the grass.

b. Operating Facilities. There are no operating facilities for the spillway. The low-level outlet is reportedly operable, but is not checked regularly. The last time it was opened was 5 years ago to release water into ponds downstream for recreational purposes. The pumps at the dam are checked daily when they are operating.

4.3 Evaluation. There are no regular programs of maintenance or technical inspections at the dam. There are also no plans for surveillance of the dam during periods of heavy rainfall, or for warning people in downstream areas in the event of an emergency at the dam. The lack of standard operating and maintenance procedures is undesirable, considering that the dam is in the high hazard category. These programs should be implemented as recommended in Section 7.3.

SECTION 5

EVALUATION OF HYDRAULIC/ HYDROLOGIC FEATURES

5.1 General. Perley Brook Dam has a 2.73-square mile drainage area, about 4.4 percent of which is ponds and swamps (see Figure D-1, Drainage Area Map). The land is hilly, and generally undeveloped.

There is one dam upstream that provides additional storage within the watershed.

Perley Brook Reservoir has a surface area of approximately 55 acres, and a maximum storage capacity of 1100 acre-feet at El 1031.7 which is the low point on the top of the dikes.

The low-level outlet can discharge a flow of 80 cfs when the reservoir is at El 1025 which is the crest of the spillway. At this reservoir elevation and with no additional inflow, the outlet can lower the reservoir by 1 foot in about 8 hours.

5.2 Design Data. Hydraulic and hydrologic computations for the design of the spillway at Perley Brook Reservoir Dam were available for review. The spillway was designed to discharge 3710 cfs at El 1029 with an allowance of 3 feet of freeboard.

5.3 Experience Data. There is no record that the original dam at this site was ever overtopped. The existing dam was designed to increase the water supply. There is no record of overtopping of the present dam, which was constructed in 1967. No records of past discharge are available.

5.4 Test Flood Analysis. Perley Brook Reservoir Dam has been classified in the "intermediate" size and "high" hazard categories. According to the Corps of Engineers guidelines, a test flood equal to the full PMF (Probable Maximum Flood) should be used to evaluate the capacity of the spillway.

The PMF rate for the Perley Brook Reservoir watershed was calculated to be 1250 cfs per square mile of drainage area. This calculation is based on the average slope of 1.4 percent in the

drainage area, the pond-plus-swamp area to drainage area ratio of 4.4 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). For this analysis, the peak flow rate was determined to be slightly above the guide curve for flat and coastal topography.

Applying the full PMF rate to the 2.73 square mile drainage area results in a peak test flood inflow of 3410 cfs. By adjusting the test flood inflow for surcharge storage, the peak test flood outflow was calculated to be 2910 cfs (1066 cfs per square mile). The reservoir level would rise to El 1032.4 during the test flood. Using one-half the PMF rate, the peak inflow is 1705 cfs. The peak outflow is 1520 cfs with the pond at El 1027.4.

Hydraulic analyses indicate that the spillway can discharge 2700 cfs or 93 percent of the test flood outflow with the pond at El 1031.7, which is the low point on the top of the dikes.

During the test flood, the dikes would be overtopped by a maximum of 0.7 feet, and the dam would be overtopped by a maximum of 0.4 feet. About 2710 cfs would discharge over the spillway, about 160 cfs would discharge over the dikes and about 40 cfs over the dam. Where critical flow occurs over the dikes, the water would be 0.4 feet deep at a velocity of 3.6 feet per second (fps). Critical flow over the dam would be less due to the lower head, and the asphalt pavement would protect the top from erosion.

The spillway is of the "morning glory" type. At lower reservoir levels discharge is controlled by the circular entrance weir. At high reservoir levels discharge is related to the throat orifice conditions or the spillway's configuration as a pipe. The point where flow stops being controlled by the weir and is controlled by throat or pipe action is indefinite. The point selected for this report is based on a conservative value of 0.61 for the throat orifice coefficient. If the actual value is higher, then the maximum reservoir elevation under the test flood becomes lower. If the actual coefficient is as high as 0.90, as was used in the original design, then the test flood outflow would be 3150 cfs with the reservoir at

elevation 1028.9. An evaluation of the actual value of the orifice coefficient will require field data under suitable high flow conditions.

5.5 Dam Failure Analysis. The peak discharge rate due to failure of the dam was calculated to be 94,400 cfs with the pond at El 1031.7. This calculation is based on a maximum head of 46.7 feet and an assumed 176-foot wide breach occurring in the embankment. Failure of the dam would produce a downstream flood flow 37 feet deep as compared to channel flow 8 feet deep prior to failure.

There is a trailer park with approximately 20 mobile homes located near Perley Brook downstream of the dam. The foundations of these structures are approximately 3 feet above the streambed. Discharge due to failure of the dam will result in overflowing of the channel, with little attenuation of the flood flow. It is likely that failure of the dam would result in excessive property damage and the loss of more than a few lives in developed areas downstream of the dam. Accordingly, the dam has been placed in the "high" hazard category.

SECTION 6

STRUCTURAL STABILITY

6.1 Visual Observations. The evaluation of the structural stability of Perley Brook Reservoir Dam is based on a review of previous inspection reports, a review of available drawings, and the visual inspection conducted on May 12, 1980.

As discussed in Section 3, Visual Inspection, the dam is in fair condition. Seepage was observed along the downstream toe of the embankment. Sinkholes were observed at the toe of the upper downstream slope. Erosion of the earthfill has occurred along the walls of the stilling basin. Some small trees are growing on the bench and lower downstream slope of the dam.

6.2 Design and Construction Data. Construction of Perley Brook Reservoir Dam was completed in 1967. Computations for design of the spillway and outlet are available. The design high water level for the reservoir is shown on the drawings as El 1029. The spillway was designed to discharge a maximum of 3170 cfs. Stability computations for the design of the dam are not available.

Drawings dated March 1962 prepared by Camp, Dresser and McKee show as-built construction of the dam (see Figures B-1 through B-4). The drawings show that the dam is an unzoned earthfill embankment founded partly on bedrock and partly on glacial till. A layer of peat is shown to be excavated at the base of the dam. The original dam at the site, which was a 10-foot high, 265-foot long concrete dam, was left in place at the base of Perley Brook Reservoir Dam except in the spillway area. The embankment is comprised mostly of impervious fill. Some random fill is shown on the top and upper downstream slope of the embankment. The bench and lower downstream slope are shown as spoil material. A cutoff trench extends up to 12 feet below the base of the dam. The trench is shown as 10 feet wide at the bottom with side slopes at 1:1. The upstream slope of the embankment is 2.5:1. The downstream slope is

2:1 in the upper section, 3 percent on the bench, and 1.5:1 in the lower section. Specifications for construction of the dam are not available.

There is no information on the shear strength or permeability of the soil and/or rock materials of the embankment. Water level readings were taken during the visual inspection from the observation wells on the downstream slope of the dam. The readings taken in May 1980 were about 1 foot lower than those taken at the end of construction in September 1967.

6.3 Post-Construction Changes. Since the original construction of the dam, no changes or repairs have been made.

6.4 Seismic Stability. The dam is located in Seismic Zone No. 2, and in accordance with Corps of Engineers' guidelines does not warrant further seismic analysis at this time.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. As a result of the visual inspection, the review of available data, and limited information on operation and maintenance, the dam is considered to be in fair condition. The following deficiencies must be corrected to assure the continued performance of this dam: seepage along the downstream toe of the embankment; sinkholes at the toe of the upper downstream slope; slope erosion adjacent to the walls of the stilling basin; leakage near the bottom of the spillway shaft; leakage through the joints of the outlet pipe; small trees growing on the bench and lower downstream slope of the dam; and debris in the sluice gate chamber, downstream channel, and on the crest of the spillway.

The peak test flood (full PMF) outflow is estimated to be 2910 cfs with the pond at El 1032.4. The test flood would overtop the low point on the dam by 0.4 feet and overtop the low point on the dikes by 0.7 feet. Hydraulic analyses indicate that the spillway can discharge 2700 cfs or 93 percent of the test flood outflow before the dikes are overtopped.

b. Adequacy. The lack of complete design and construction data did not allow for a definitive review. Therefore, the evaluation of this dam is based on a review of the available data, the visual inspection, past performance and engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within 1 year after receipt of this Phase I Inspection Report.

7.2 Recommendations. It is recommended that the Owner employ a qualified registered engineer to:

a. Evaluate the stability of the dam, including an investigation of the seepage noted at the toe of the embankment and an investigation of the sinkholes on the downstream slope of the embankment.

b. Make recommendations on repairing the leakage near the bottom of the spillway shaft and through the joints in the concrete outlet pipe. This should include an inspection of the spillway under a no flow condition.

The Owner should implement the recommendations of the Engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. It is recommended that the Owner accomplish the following:

(1) Place additional earthfill adjacent to the walls of the stilling basin and protect the fill from erosion.

(2) Remove all wood and trash, debris from the sluice gate chamber and from the floor of the discharge channel.

(3) Remove logs and debris caught on the spillway weir.

(4) Selectively clear trees, brush and roots from the dam embankment, and to a distance of 25 feet from the toe of the dam. All stumps and roots removed should be backfilled with select material.

(5) Institute a definite plan for surveillance of the dam and spillway during and after periods of heavy rainfall and a plan to warn people in downstream areas in the event of an emergency at the dam.

(6) Implement a systematic program of maintenance inspections. As a minimum, the inspection program should consist of a

monthly inspection of the dam and appurtenances and be supplemented by additional inspections during and after severe storms. These inspections should include a program to monitor the groundwater levels in the observation wells. All repairs and maintenance should be undertaken in compliance with all applicable State regulations. The maintenance program should include removal of any debris caught on the spillway weir to prevent clogging of the spillway.

(7) Institute a program of technical inspections of this dam on an annual basis.

7.4 Alternatives. There are no practical alternatives to the above recommendations.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

PERLEY BROOK RESERVOIR DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT PERLEY BROOK RESERVOIR DAM

DATE May 12, 1980

Abbreviations:

U.S. = upstream
D.S. = downstream
N.A. = not applicable

TIME 0800

WEATHER Cloudy & rain

W.S. ELEV. 1025.0* U.S. 984.7* D.S.
*based on assumed benchmark at El. 1006.0 at top of stilling basin wall

PARTY:

1. John Risitano Metcalf & Eddy - Geotechnical
2. Ed Greco Metcalf & Eddy - Geotechnical
3. Lyle Branagan Metcalf & Eddy - Hydraulics
4. Warren Diesl Metcalf & Eddy - Geotechnical
5. Bill Checchi Metcalf & Eddy - Geotechnical

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam	Risitano/Greco	
2.	Spillway	Risitano/Branagan	
3.	Outlet	Risitano/Branagan	
4.	Pumping Station	Risitano/Greco	
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Embankment NAME John Risitano

DISCIPLINE Geotechnical NAME Ed Greco

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	1032.0 to 1034.5
Current Pool Elevation	1025.0
Maximum Impoundment to Date	Unknown
Surface Cracks	Transverse cracks in pavement-1" max.width -more frequent on Beagle Club Road.
Pavement Condition	Fair
Movement or Settlement of Crest	None visible
Lateral Movement	None visible
Vertical Alignment	Relatively flat
Horizontal Alignment	Relatively straight
Condition at Abutment and at Concrete Structures	Good-erosion due to surface runoff & trespassing along walls of stilling basin.
Indications of Movement of Structural Items on Slopes	None visible
Trespassing on Slopes	Along roadway and walls of stilling basin.
Sloughing or Erosion of Slopes or Abutments	Several sinkholes 1' to 4' deep along toe of upper DS slope
Rock Slope Protection - Riprap Failures	Riprap on upstream slope in good condition.
Unusual Movement or Cracking at or near Toes	Several sinkholes 1' to 4' deep along toe of upper DS slope
Unusual Embankment or Downstream Seepage	Several seeps at toe of lower DS slope near stilling basin-flowing with orange sediment.
Piping or Boils	None visible
Foundation Drainage Features	Drawings show gravel around outlet pipe and stilling basin walls
Toe Drains	Gravel drain shown on drawings at toe of DS slope
Instrumentation System	6 observation wells on upper DS slope- 3 at Sta.4+50, 3 at Sta. 6+50

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Spillway NAME John Risitano

DISCIPLINE Geotechnical NAME Lyle Branagan

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	None
General Condition	N.A.
Loose Rock Overhanging Channel	N.A.
Trees Overhanging Channel	N.A.
Floor of Approach Channel	N.A.
b. Weir and Training Walls	Morning Glory weir with 5 concrete piers to support pumping station.
General Condition of Concrete	Slight deterioration of concrete weir: fair
Rust or Staining	None visible
Spalling	None visible
Any Visible Reinforcing	None visible
Any Seepage or Efflorescence	None visible
Drain Holes	None visible
c. Discharge Channel	Vertical circular concrete shaft leading to outlet pipe
General Condition	Fair-leakage around concrete plug near bottom of shaft
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Channel	Bottom of shaft not examined due to water discharging
Other Obstructions	None

Note: Four strands of barbed wire acting as a log boom broken in some places, located between columns above weir.

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Outlet Pipe NAME John Risitano

DISCIPLINE Geotechnical NAME Lyle Branagen

AREA EVALUATED	CONDITION
LOW-LEVEL OUTLET	
a. Approach Channel	
Slope Conditions	Submerged beneath 35' of water
Bottom Conditions	Not visible
Rock Slides or Falls	N.A.
Log Boom	N.A.
Debris	None visible
Condition of Concrete Lining	Not visible
Drains or Weep Holes	None visible
b. Intake Structure	Access door bolted shut to prevent vandalism
Condition of Concrete	Good
Stop Logs and Slots	N.A. sluice gate

Note: Wood, trash and rock debris inside chamber.

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Outlet Pipe NAME John Risitano

DISCIPLINE Geotechnical NAME Lyle Branagan

AREA EVALUATED	CONDITION
OUTLET PIPE	12-foot diameter R.C.pipe
General Condition of Concrete	Poor
Rust or Staining on Concrete	Efflorescence at all joints; leakage at joint with spillway shaft and at 5th & 7th joints downstream
Spalling	None visible
Erosion or Cavitation	None visible
Cracking	Minor
Alignment of Monoliths	N.A.
Alignment of Joints	Pipe joints good
Numbering of Monoliths	N.A.

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Stilling Basin NAME John Risitano

DISCIPLINE Geotechnical NAME Lyle Branagan

AREA EVALUATED	CONDITION
OUTLET PIPE-STILLING BASIN AND DOWNSTREAM CHANNEL	Concrete stilling basin with 5 flow diverters in discharge channel
General Condition of Concrete	Good
Rust or Staining	Some visible
Spalling	A few locations ground outlet pipe with some minor cracking in basin walls
Erosion or Cavitation	None visible
Visible Reinforcing	None visible
Any Seepage or Efflorescence	Some with one wet spot on right wall
Condition at Joints	Good
Drain Holes	None visible
Channel	20-foot wide stone-lined stream bed downstream of stilling basin.
Loose Rock or Trees Overhanging Channel	Small trees and bushes growing at base of left wing wall of basin.
Condition of Discharge Channel	Some wood and trash debris

DISCHARGE CHANNEL- 20-foot wide stream bed, bottom lined with stone - condition is fair - some trees overhanging channel - some wood and trash debris in channel.

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Pumping Station NAME John Risitano

DISCIPLINE Geotechnical NAME Ed Greco

AREA EVALUATED	CONDITION
PUMPING STATION	Concrete deck with masonry facade supported by piers over spillway.
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Fair
Spalling	None visible
Visible Reinforcing	None visible
Rusting or Staining of Concrete	None visible
Any Seepage or Efflorescence	None visible
Joint Alignment	Good
Unusual Seepage or Leaks in Gate	None visible
Cracks	None visible
Rusting or Corrosion of Steel	None visible
b. Mechanical and Electrical	NOTE: Two pumps, one as a spare, pumping into 14-inch pipeline under Clark Street to Crystal Lake (water supply reservoir)
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE MAY 12, 1980

PROJECT FEATURE Bridge to Pumping Station NAME John Risitano

DISCIPLINE Geotechnical NAME Ed Greco

AREA EVALUATED	CONDITION
PUMPING STATION - BRIDGE a. Super Structure	Vehicular & pedestrian service bridge of beam and deck design
Bearings	N.A.
Anchor Bolts	N.A.
Bridge Seat	Cast-in-place concrete abutment with wing walls
Longitudinal Members	Cast-in-place concrete beams
Under Side of Deck	Good condition
Secondary Bracing	N.A.
Deck	Asphalt pavement on concrete deck
Drainage System	Sloping toward Clark Street
Railings	Good condition
Expansion Joints	None visible
Paint	Paint on railings in fair condition with some rust spots
b. Abutment and Piers	
General Condition of Concrete	Good
Alignment of Abutment	Good
Approach to Bridge	Paved; cracked at start of bridge deck
Condition of Seat and Backwall	Good

PERIODIC INSPECTION CHECK LIST

PROJECT PERLEY BROOK RESERVOIR DAM DATE May 12, 1980

PROJECT FEATURE Dikes NAME John Risitano

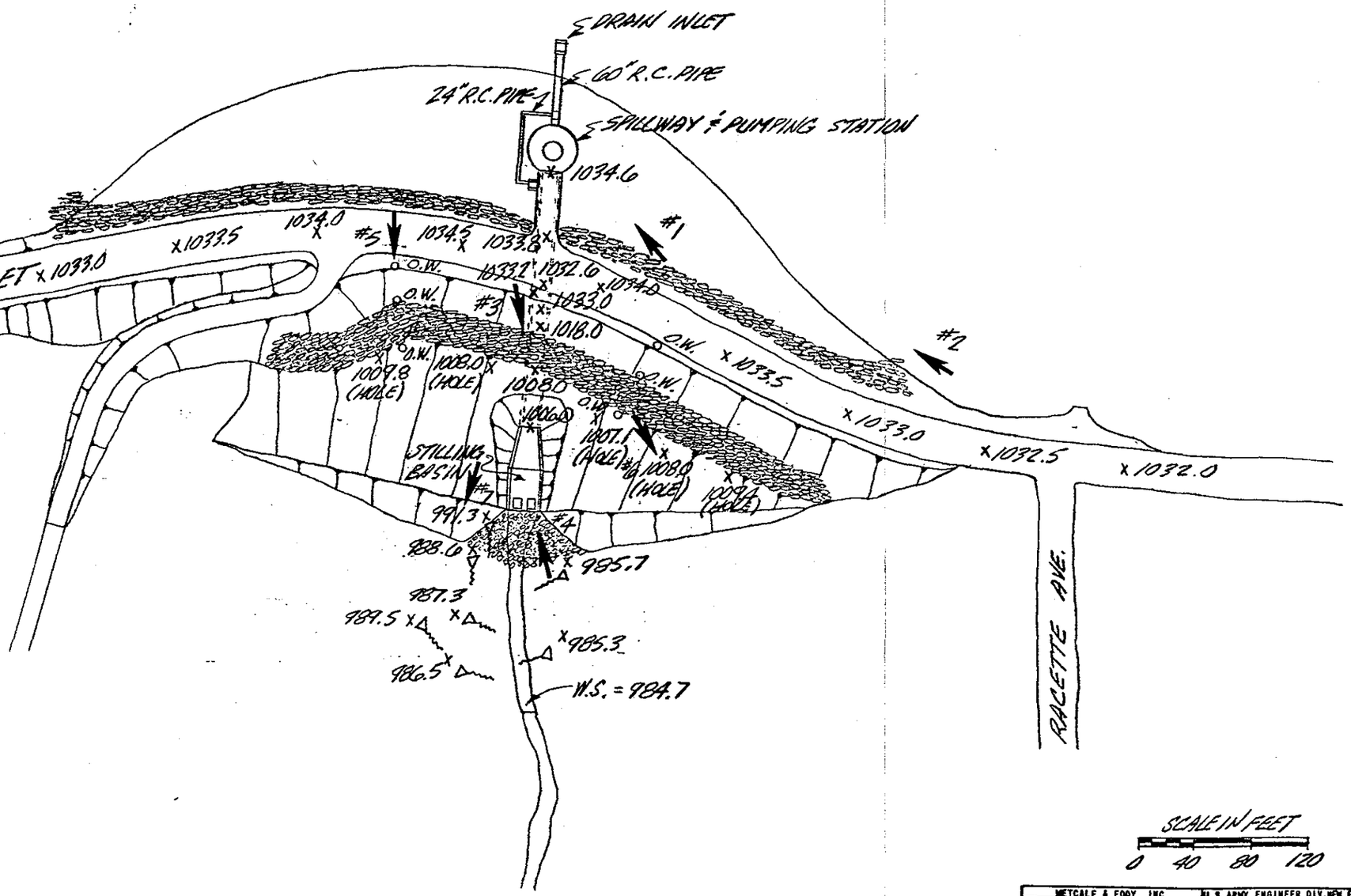
DISCIPLINE Geotechnical NAME Ed Greco

AREA EVALUATED	CONDITION
DIKE EMBANKMENT Crest Elevation	Four earthfill Dikes: Dike #1 El. 1032.0 Dike #3 breached Dike #2 breached Dike #4 El. 1031.7
Current Pool Elevation	El. 1025.0
Maximum Impoundment to Date	Unknown
Surface Cracks	N.A.
Pavement Condition	N.A.
Movement or Settlement of Crest	None visible
Lateral Movement	None visible
Vertical Alignment	Relatively flat
Horizontal Alignment	Relatively straight
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None visible
Trespassing on Slopes	Along toe; dirt bike paths
Sloughing or Erosion of Slopes or Abutments	None visible
Rock Slope Protection - Riprap Failures	24" stone riprap; no failures observed
Unusual Movement or Cracking at or near Toes	None visible
Unusual Embankment or Downstream Seepage	None visible
Piping or Boils	None visible
Foundation Drainage Features	None visible
Toe Drains	None visible
Instrumentation System	None

APPENDIX B

PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS

PERLEY BROOK RESERVOIR
W.S. EL. 1025.0



ELEVATIONS SHOWN BASED ON TOP OF SIDEWALL - STILLING BASIN ELEV. 1006.00 (NGVD), AS SHOWN ON FIGURE B-4.
INFORMATION SHOWN BASED UPON A FIELD INSPECTION ON MAY 12, 1980.
▽ INDICATES SEEPAGE.
INDICATES LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS.

SCALE IN FEET
0 40 80 120

METCALF & EDDY, INC. ENGINEERS BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

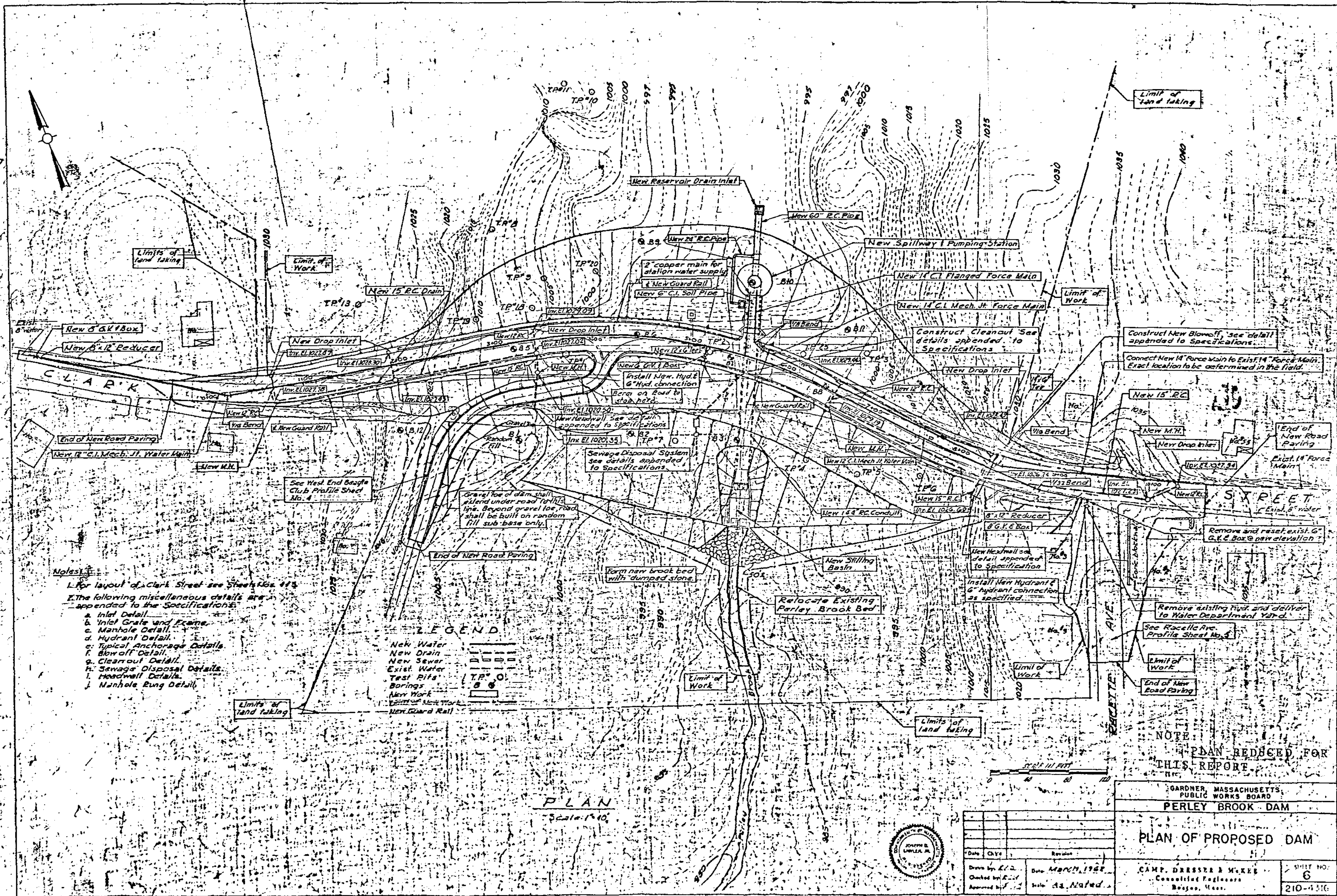
PERLEY BROOK RESERVOIR DAM

FIGURE B-1 PLAN OF DAM

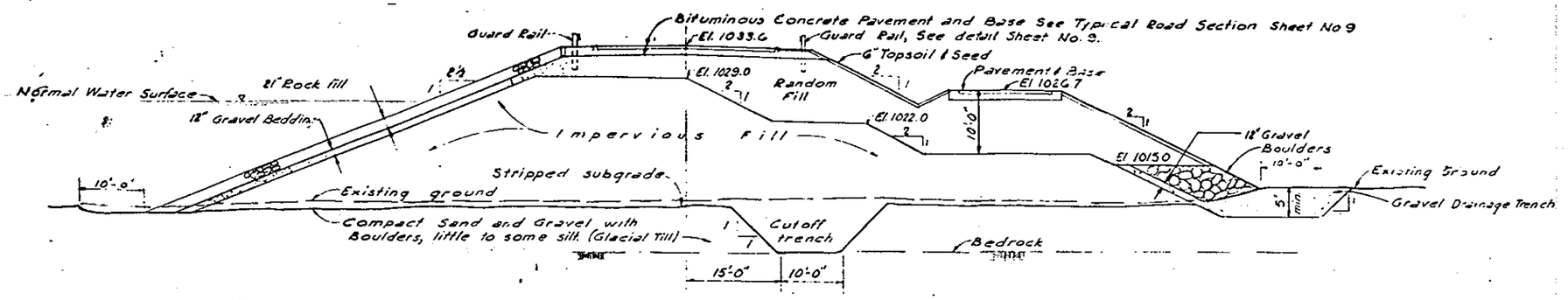
TRIBUTARY CONNECTICUT RIVER — MASSACHUSETTS

SCALE: AS SHOWN | DATE: MAY, 1980

METCALF & EDDY, INC.

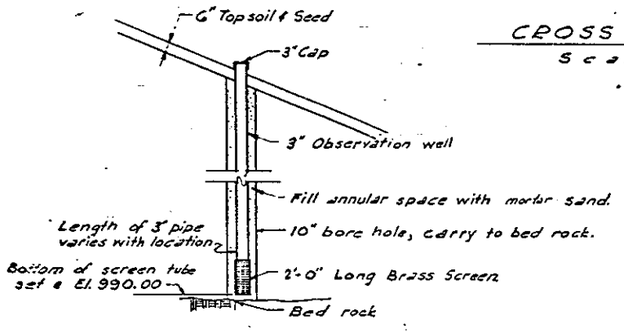


PERLEY BROOK RESERVOIR DAM FIGURE B-2



CROSS SECTION @ STA 3+20

Scale: 1"=10'-0"



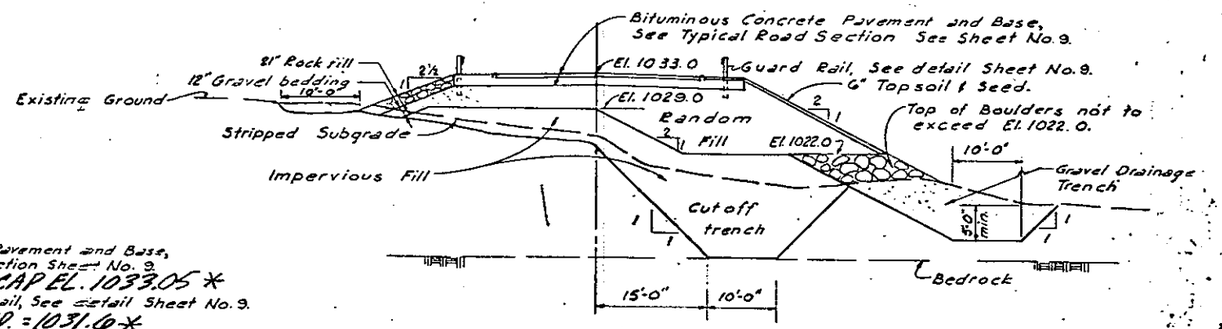
OBSERVATION WELL DETAIL

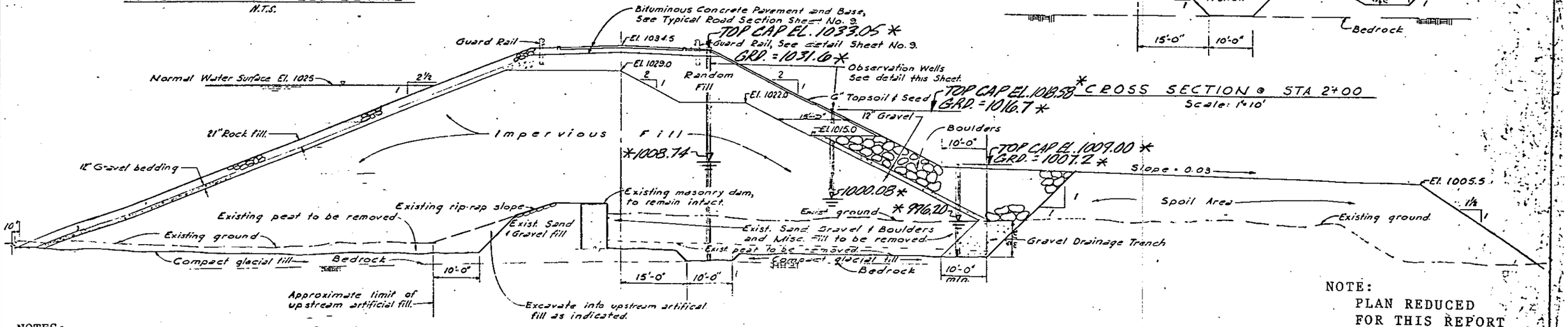
N.T.S.

Note:
Observation wells to be located at stations 4+50 and 6+50 as shown on cross section below.
6 Observation wells required.

Notes:

1. Boulders may be stopped anywhere above El. 1015.0 but in no case shall the top of the boulders exceed El. 1022.0. Random fill may then be used above boulders within designated zone.
2. Random fill slopes where indicated on the sections are to be finished with 6 inches of seeded top soil.
3. Foundation preparation shall extend 10 feet beyond upstream toe of dam, and 10 feet beyond downstream toe of dam.
4. Cutoff trench not required where existing ground is higher than El. 1020.0.
5. Gravel toe fill not required where existing ground is higher than El. 1020.0.
6. Existing soil conditions shown, have been generalized on basis of subsurface explorations.
7. Boring and Test Pit logs are appended to the specifications.





CROSS SECTION @ STA 2+00

Scale: 1"=10'

CROSS SECTION @ STA. 6+50

Scale: 1"=10'

NOTES:

1. Water levels in observation wells were measured on 12 May 80.
2. *Elevations verified in field on 12 May 80, and based on an assumed benchmark elevation 1006.0 (NGVD) at top of stilling basin.

NOTE:
PLAN REDUCED FOR THIS REPORT

SCALE IN FEET
0 5 10 20 30

GARDNER, MASSACHUSETTS
PUBLIC WORKS BOARD
PERLEY BROOK DAM

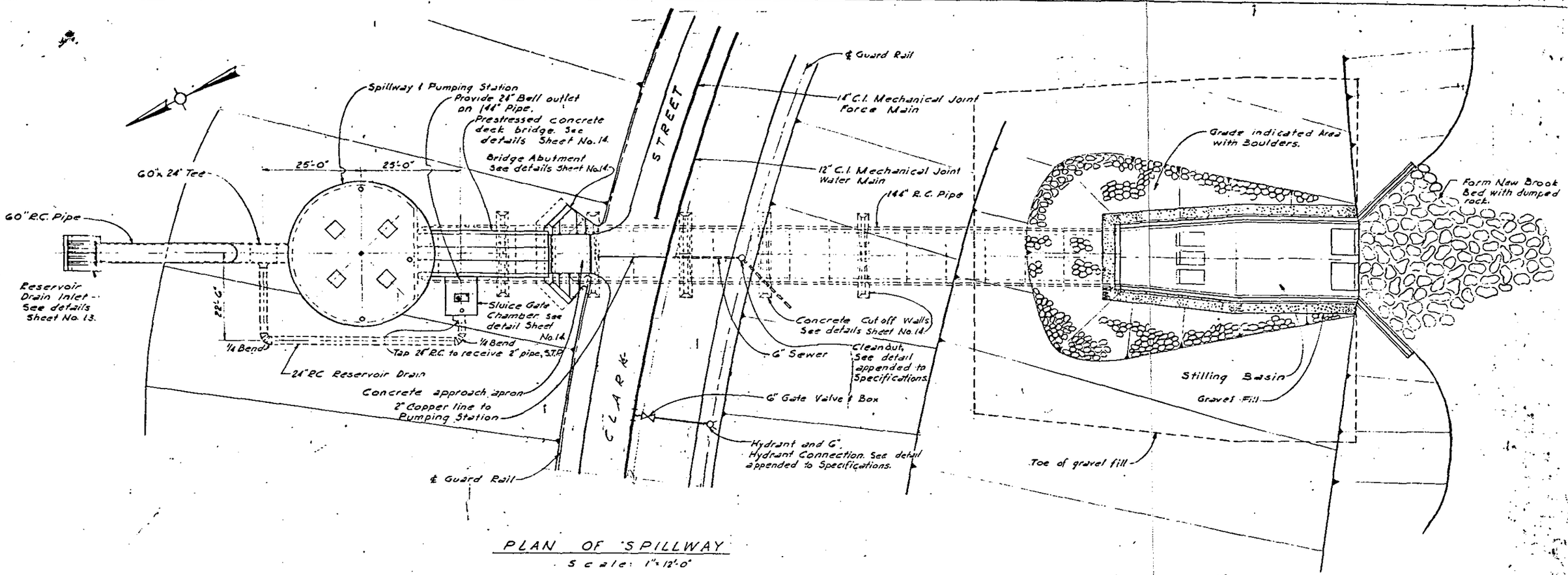
CROSS-SECTIONS OF DAM

Date	Chkd.	Revision

Drawn by: EAD
Checked by: RCU
Approved by: KHB
Date: March, 1982
Scale: As Noted

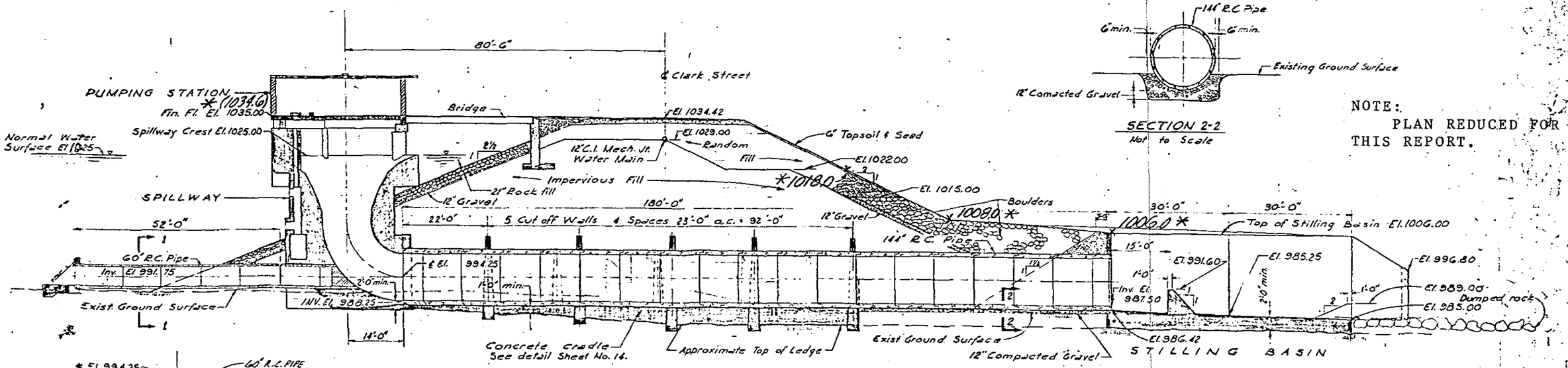
CAMP, DRESSER & McKEE
Consulting Engineers
Boston, Mass.

SHEET NO. 8
210-4318



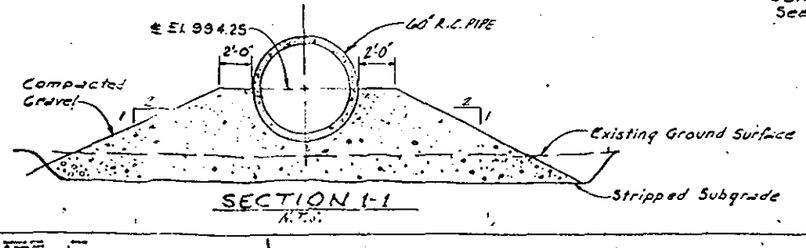
PLAN OF SPILLWAY

Scale: 1"=12'-0"



SECTION THRU SPILLWAY

Scale: 1"=12'-0"



SECTION 1-1

N.T.S.

SECTION 2-2

Not to Scale

NOTE:

PLAN REDUCED FOR THIS REPORT.

NOTE:

1. *Elevations verified in field on 12 May 80, and based on an assumed benchmark elevation 1006.0 (NGVD) at top of stilling basin.

SCALE IN FEET 0 6 12 24 30

No.	Date	Revision

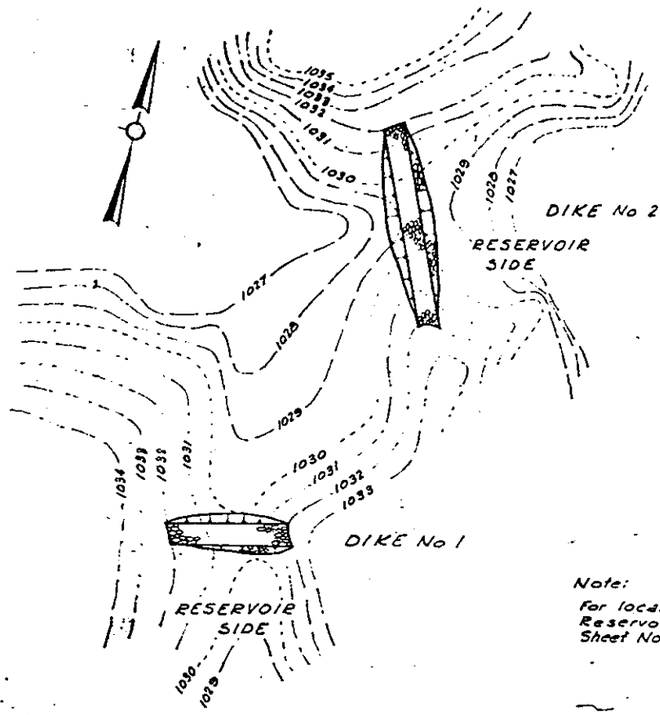
Drawn by EAD — Date March 1982
Checked by RCAL
Approved by [illegible]
Scale As indicated

GARDNER, MASSACHUSETTS
PUBLIC WORKS BOARD
PERLEY BROOK DAM

SPILLWAY
PLAN & PROFILE

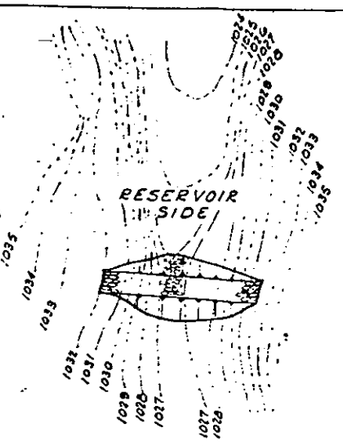
CAMP, DRESSER & McKEE
Consulting Engineers
Boston, Mass.

SHEET NO 10
210-4320

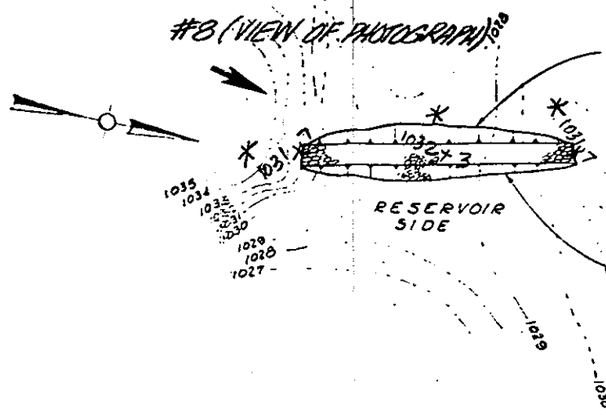


PLAN DIKE SITES No. 1 and No. 2
Scale: 1" = 40'

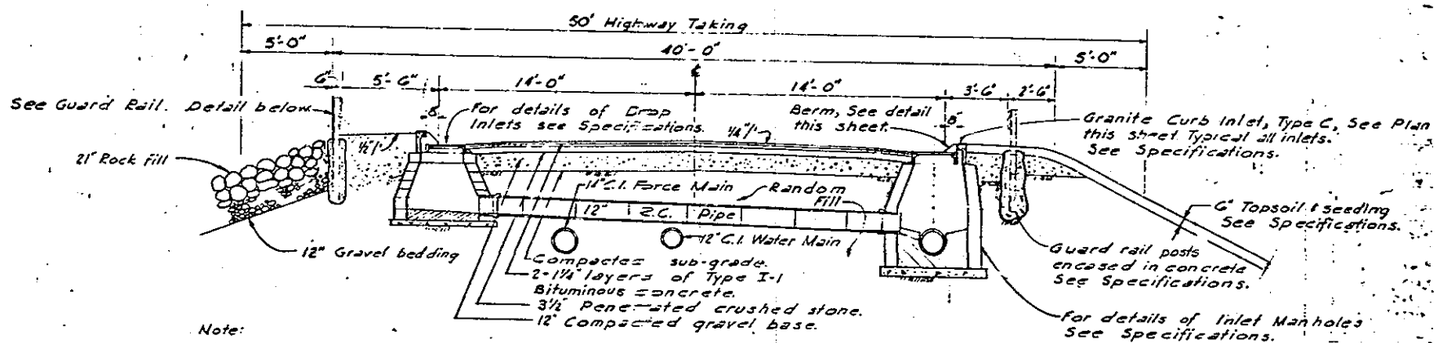
Note:
For location of dikes on Reservoir Site. See Sheet No. 2.



PLAN DIKE SITE No. 3
Scale: 1" = 40'

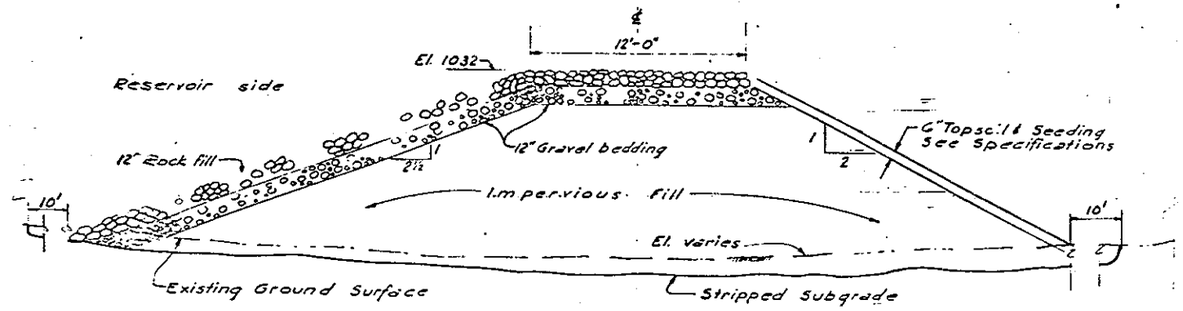


PLAN DIKE SITE No. 4
Scale: 1" = 40'

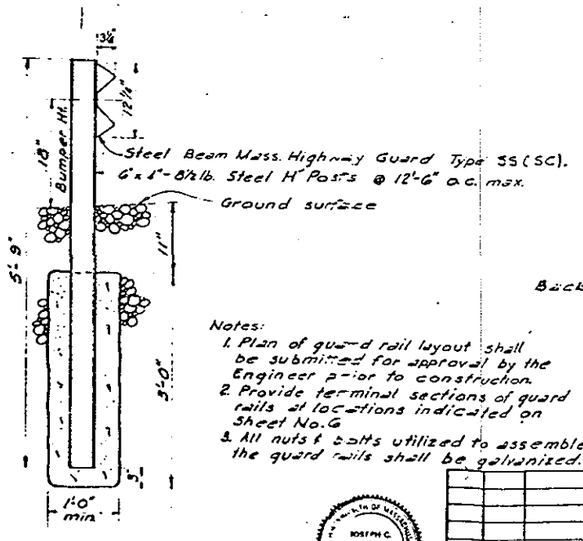


Note:
Pavement and base for Racette Ave. & The West End Beagle Club Road shall be identical to this Section except that no berm is required unless shown otherwise on Sheet No. 6.

TYPICAL ROAD SECTION
Scale: ½" = 1'-0"

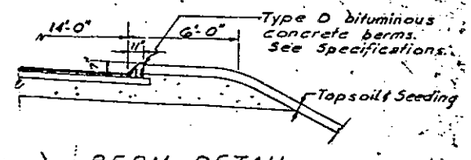


TYPICAL SECTION THRU DIKES
Scale: ½" = 1'-0"

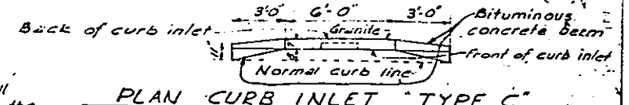


GUARD RAIL DETAIL
Scale: 1" = 1'-0"

Notes:
1. Plan of guard rail layout shall be submitted for approval by the Engineer prior to construction.
2. Provide terminal sections of guard rails at locations indicated on Sheet No. 6
3. All nuts & bolts utilized to assemble the guard rails shall be galvanized.



BERM DETAIL
Scale: ½" = 1'-0"



PLAN CURB INLET "TYPE C"
Scale: ½" = 1'-0"

NOTE:

1. *Elevations verified in field on 12 May 80, and based on an assumed benchmark elevation 1006.0 (NGVD) at top of stilling basin.

NOTE:
PLAN REDUCED FOR THIS REPORT

GARDNER, MASSACHUSETTS
PUBLIC WORKS BOARD
PERLEY BROOK DAM

DIKE & ROAD DETAILS

Date	Ch'd.	Revision

Drawn by: EAD
Checked by: ECM
Approved by: [illegible]
Date: March, 1982
Scale: As Noted

CAMP, DRESSER & McKEE
Consulting Engineers
Boston, Mass.

SHEET NO. 9
210-4319

)WN Gardner DAM NO. 17-13

)CATION Clark Street STREAM Perley Brook
"Perley Brook Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

med by City of Gardner Place Water Dept. Use Water Supply

ispected by WOC - E. Tier, City Engr. Date Oct. 14, 1965.

ype of Dam Earth - Concrete Condition Under construction

?ILLWAY

.ashboards in Place _____ Recent Repairs _____

)ndition Concrete intake structure under construction

)pairs Needed _____

Contractor is Paul L. Flanagan & Sons

IBANKMENT

)cent Repairs Under construction. Work on this project is supposed to

)ndition be completed by Jan. 15, 1966.

)pairs Needed Resident Engr (Chester Pease) and Soil Engineer are on job for Consulting firm of (Camp-Dresser and McKee, Boston)
(Tel. Number in Gardner is 632-5362)

TES

)cent Repairs Gate under construction.

)ndition "Resident Engr will have a set of prints showing changes

)pairs Needed etc in original plans, sent to County Engineer, when this project is completed."

AKS

w Serious _____

TE: _____ County Engineer

OWN Gardner DAM NO. 17-13

OCATION Nly side of Clark St STREAM Perley Brook

"Perley Brook Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

wned by City of Gardner Place Water Dept. Use Water Supply.

nspected by JCT - WOL Date Oct. 14, 1966.

ype of Dam Earth - Concrete Condition Under construction.

PILLWAY

lashboards in Place _____ Recent Repairs _____

ondition New construction

epairs Needed New contractor on this project is "McDonald & Donovan Inc Barre, Mass.

MBANKMENT

ecent Repairs _____

ondition New construction.

epairs Needed Inspector for Consulting Engrs says that fill and riprap will be completed by Nov. 15.

ATES

ecent Repairs _____

ondition _____

epairs Needed _____

AKS

ow Serious _____

ATE: _____ County Engineer

TOWN Gardner DAM NO. 17-13

LOCATION Clark St STREAM Perley Brook

"Perley Brook Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by City of Gardner Place Water Dept Use Water supply

Inspected by JET-W.C.E.-E.Tier (City Engr.) Date Jan 16, 1967

Type of Dam Highway Embankment Condition Under construction

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition Workmen are now installing pumps, etc. and constructing

Repairs Needed gate house. Work on this project is 85% completed

EMBANKMENT

Recent Repairs Embankment is completed except for roadway, guard

Condition rail, etc. and additional riprap on upstream slope.

Repairs Needed Water level at present time is higher than normal

height in old reservoir

GATES

Recent Repairs _____

Conditions Gate is closed

Repairs Needed _____

LEAKS

How Serious No leaks are visible.

DATE: _____ _____

County Engineer

TOWN Gardner DAM NO. 17-1.3

LOCATION Clark St STREAM Perley Brook

"Perley Brook Reservoir"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

)wned by City of Gardner Place Water Dept. Use Water supply

:nspected by WOC Date Oct 3, 1967

'ype of Dam Highway Embankment Condition Good condition

PILLWAY

lashboards in Place No boards Recent Repairs

ondition Good condition

epairs Needed (Pond is full to spillway crest.)

MBANKMENT

ecent Repairs

)ndition Good condition

epairs Needed

ATES

cent Repairs

)nditions Good condition

pairs Needed

AKS

w Serious No leaks are visible.

TE:

County Engineer

TOWN Gardner DAM NO. 17-13

LOCATION Perley Brook Res STREAM Perley Brook

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by City of Gardner Place _____ Use Water Supply

Inspected by M.E. Hunt Date Nov 21 1968

Type of Dam New Dam 1966 Condition _____

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition OK

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition OK

Repairs Needed _____

GATES

Recent Repairs _____

Condition OK

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

APPENDIX C

PHOTOGRAPHS

Note: Location and direction of photographs shown on Figures B-1 and B-5 in Appendix B.

NO. 1 VIEW OF PUMP STATION AND SPILLWAY

NO. 2 VIEW OF UPSTREAM SLOPE

NO. 3 VIEW OF DOWNSTREAM CHANNEL

NO. 4 VIEW OF STILLING BASIN

NO. 5 OBSERVATION WELLS ON DOWNSTREAM SLOPE

NO. 6 SINKHOLE AT TOE OF UPPER DOWNSTREAM SLOPE

NO. 7 VIEW OF SEEPAGE AREA AT DOWNSTREAM TOE

NO. 8 VIEW OF DIKE NO. 4

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

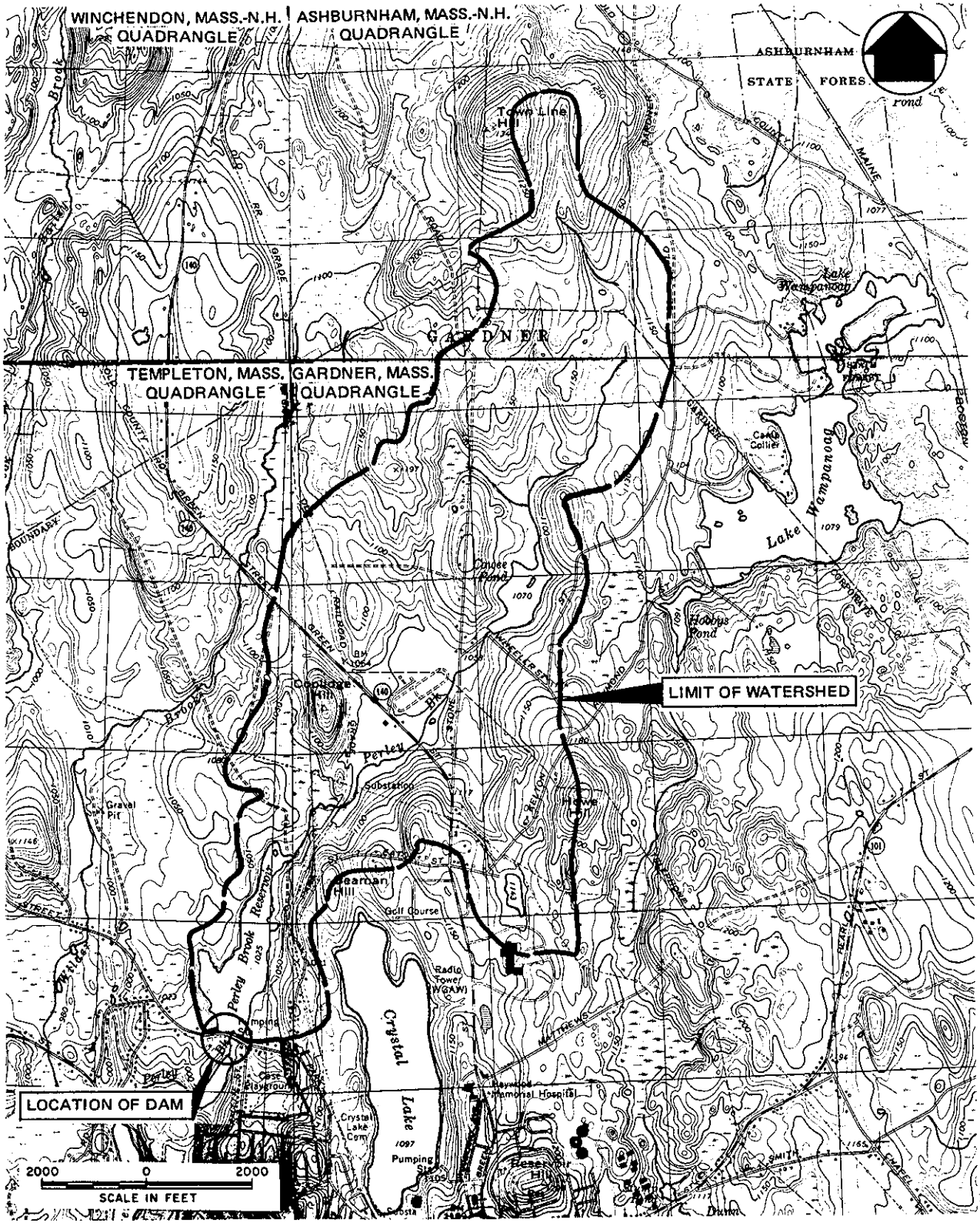


FIG. D-1 DRAINAGE AREA MAP

PERLEY BROOK RESERVOIR DAM

Project Nat. Review of Non Fed. Dams Acct. No. 6926 Page 1 of 6
Subject Worcester County, Mass. Comptd. By LEB Date 6/9/80
Detail Perley Brook Reservoir Ck'd. By RDH Date 6/13/80

(I) Test Flood, Storage & Storage Function

1- Total Drainage Area - 2.73 mi^2

2- Pond(s) Area: .03 mi^2
Swamp(s) Area: .09 "
Total Area Pond(s) & Swamp(s): .12 "

% Ponds & Swamps = $\frac{.12}{2.73} \approx 4.4\%$

3- $\frac{1325-1025}{20700} = .0145$ } Say Ave Slope = 1.4%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be somewhat above "Flat & Coastal", and taken at 1250 c.f.s./mi²
Size Class: Interm.; Hazard Pot.: High; Spill. Des. Flood: Full PMF
Use: Test Flood = Full PMF

5- Test Flood Inflow = (1250) 2.73 = 3410 c.f.s.

6- Pond Storage
The pond area is .086 sq. mi. at elev. 1025
Based on a const. area, storage increases at 55 ac. feet per foot of depth increase.

7- Spillway crest elev. is 1025

8- Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$
S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12\,D\left(\frac{.086}{2.73}\right) = 0.378\,D$; R = 6hr rain of storm
D = Storage depth in feet above spillway crest in reservoir

9- Storage Functions: (Test Flood & ½ PMF - if needed)

$F_{TF} = 3410 - 179.5\,S = 3410 - 67.8\,D$	
$F_{½\,PMF} = 1700 - 179.5\,S = 1700 - 67.8\,D$	

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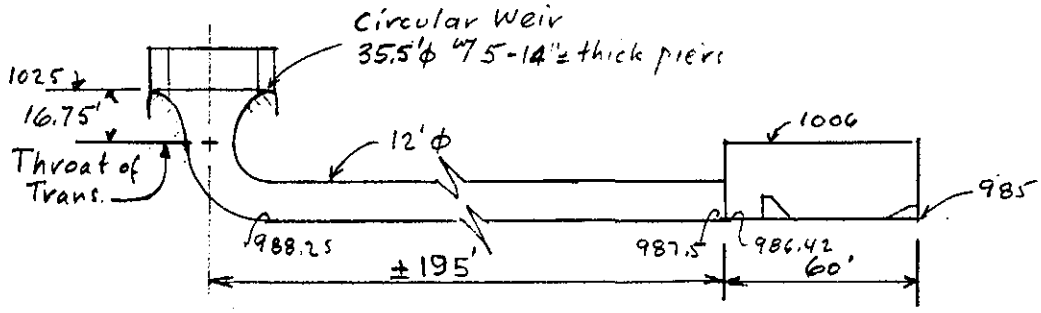
(II) Discharge Relations

1- Spillway



A - Crest Control (Ref. U.S.BR. "Des. of Small Dams" 2nd ed. - fig. 283)

Crest length ≈ $\pi(35.5) - 5(1.17) \cong 105$ ft.

$Q_A = C_o L H_o^{1.5}$ - C_o taken from Fig 283 - $P/R_s = 15/18$ - Use Pts Curv. P/R_c: 2 & 0.3

Res. Elev.	1026	1027	1028	1029	1030	1025.5	1026.5	1027.5
H_o	1	2	3	4	5	0.5	1.5	2.5
H_o/R_s	.06	.11	.17	.22	.28	.03	.08	.14
C_o	4±	4±	3.95	3.91	3.83	4±	4±	4±
Q_A	420	1190	2160	3280	4500	150	770	1660

B - Throat Control

$A_T = 113$; Head = $16.75' + H_o$; $C = 0.611$*; $Q_B = C A_T \sqrt{2g} H = 554.5\sqrt{H}$

Res El.	1027	1028	1029	1030	1031	1032	1033	1034
H	18.75	19.75	20.75	21.75	22.75	23.75	24.75	25.75
Q_B	2400	2460	2530	2590	2640	2700	2760	2810

* C value used is minimum. Higher value likely - but needs model or field verification

C - Pipe Control

Assume T.W. to Top Pipe ±; H_c = Res El. − 1000 = $\frac{V^2}{2g}\left[0.2 + 1.0 + 0.3 + \frac{200}{12}(.07)\right]$

$V = 6.01\sqrt{H_c}$

Res El.	1030	1029	1028
V	32.9	32.4	31.8
Q_c	3719	3656	3593

Note: "Pipe Control" is not significant for this case.

(II) Discharge Relations (Cont.)

2- Dike Crest Flow

Flow over dikes #1, #2 & #3 apparently would be trapped behind Clark St. - with negligible net discharge, if any. The following applies to dike #4 only. $q = 2.55\ h^{1.5}$ dike length 150 feet - say 50ft @ 1032.3 & 100ft @ 1031.7

Res El.	1032	1032.5	1033	1033.5	1034	1034.5	1035
Q_A	40	180	380	620	890	1190	1530
Q_B	—	10	70	170	280	420	570
ΣQ	40	190	450	790	1170	1610	2100

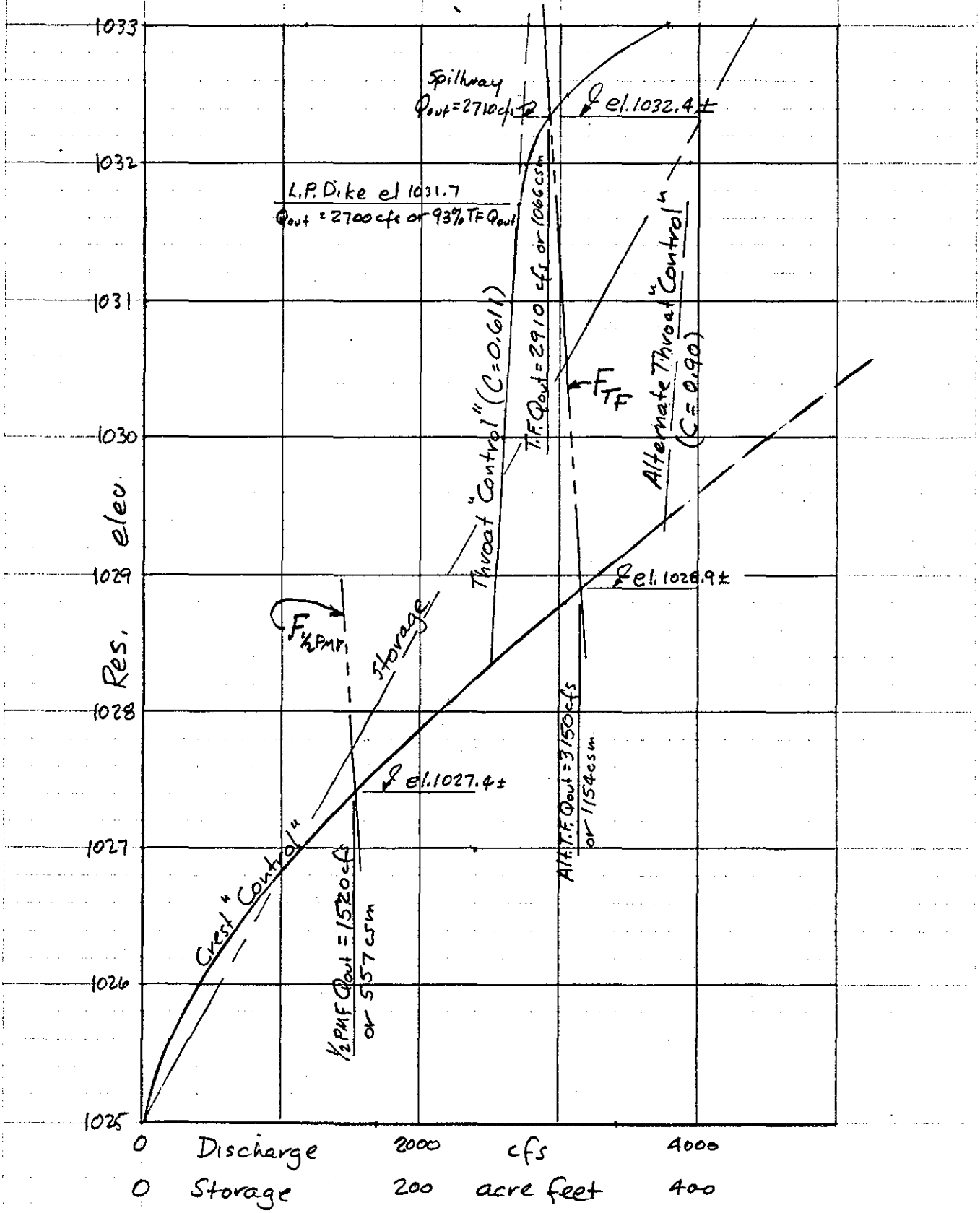
3- Clark St. Crest Flow

$q = 2.55\ h^{1.5}$; 150' @ 1032; 200' @ 1032.5, 200' @ 1033, 200' @ 1033.5, 300' @ 1034

Res El.	1032.5	1033	1033.5	1034
Q_A	140	380	700	1080
Q_B	—	180	510	940
Q_C	—	—	180	510
Q_D	—	—	—	180
ΣQ	140	560	1390	2710

Project Nat. Review of Non Federal Dams Acct. No. 6926 Page 4 of 6
Subject Worcester County, Mass. Comptd. By LEB Date 6/23/80
Detail PERLEY BROOK RES. Ck'd. By JRR Date 7/2/80

III Discharge, Storage & Storage Function vs Res. Elevation



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(IV) Test Flood Crest Flow

Test Flood Elev. - 1032.4
Low Pt. on Crest - 1031.7 (Dike #4)
Max. Head 0.7 feet

Crest Flow - cfs/ft. = $q = 2.55(0.7)^{1.5} = 1.49$

Where flow is critical: $y_c = 0.41$ ft.; $V_c = 3.6$ fps

(V) Low Level Outlet

Description: 85'± of 24"Φ w/ 2-90° bends; ℄ el. 994.25

$$H = \frac{V^2}{2g}\left[0.5 + 1.0 + 2(.5) + \frac{85}{2}(.013)\right] = 3.05\frac{V^2}{2g}; \quad V = 4.59\sqrt{H}; \quad Q = 14.4\sqrt{H}$$

(0.5 ent, 1.0 exit, 2(.5) bends, $\frac{85}{2}(.013)$ fric)

Water Elev	1025	1024
Head	30.75	29.75
Q	80	78.7

Ave. Q over 12" range = 79.35

Time to lower water 12" = $\frac{43560(55)}{3600(79.35)} = 8.4$ hours or 503 min.

(VI) Failure of Dam

Peak Failure Flow:

Pond Elevation - 1031.7
Toe Elevation — 985 ±
Y_o = 46.7

Dam Length Subject to Breaching = 440 ft.

$W_o = 40\%(440) = 176$ ft.

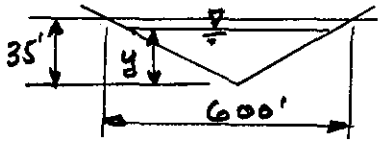
$$Q_{P_1} = 1.68\, W_o\, (Y_o)^{1.5} = 1.68\,(176)(46.7)^{1.5} = 94400 \text{ cfs}$$

Spillway disch. 2700 cfs - will cease before failure is complete.

Storage Volume Released:

Storage Above Spillway 6.7 (55) = 369 ac. ft.
Storage Below Spillway 1/3 40(55) = 733 " "
S = Total Storage = 1102 " "

Channel Hydraulics:



$S \simeq \frac{5}{800}$; $n \simeq 0.10$; $R \simeq \frac{1}{2}y$; $V = 0.742\, y^{2/3}$

$A = 8.57\, y^2$

y	A	V	Q
5	214	2.17	464
10	857	3.44	2950
15	1928	4.51	8700
20	3428	5.47	18700
25	5356	6.34	34000
30	7713	7.16	55300
35	10498	7.94	83400
37	11732	8.24	96700

Failure flow would rapidly fill small pond just downstr. At full failure flow at ±37 foot depth would issue from narrow reach just below small pond, moving across flat lands, just northeast of West St, which presently contains a cluster of mobile homes.

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APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

PERLEY BROOK RESERVOIR DAM